(12) UK Patent Application (19) GB (11) 2 159 923 A

(43) Application published 11 Dec 1985

(21) Application No 8506651

(22) Date of filing 14 Mar 1985

(30) Priority data

(31) 3409677 (32) 16 Mar 1984 (33) DE
3446210 19 Dec 1984
3503898 6 Feb 1985

(51) INT CL⁴
F16K 17/04

(52) Domestic classification
F2V V16 W27
U1S 1247 F2V

(56) Documents cited
GB A 2133121 GB 0793724
GB A 2018954 GB 0792781
GB 1336446

(58) Field of search
F2V

(71) Applicant
Gat Grubenausbau GmbH, (F. R. Germany),
Gustav-Heinemann-Strasse 27, 5840 Schwerte, Federal Republic of Germany

(72) Inventor
Richard Voss

(74) Agent and/or address for service
Matthews, Haddan & Co., Haddan House, 33 Elmfield Road, Bromley, Kent, BR1 1SU

(54) Pressure limiting valve

(57) In a pressure limiting valve, particularly for hydraulic lining in underground mining and tunnelling, and comprising a spring-loaded valve piston 6 sealed by an O-ring 17 and a valve spring retainer 8 whose underside is of streamlined construction, the valve body 2 includes through passages 26, 27 and abutments 25 which respectively allow passage of fluid past, and limit the travel of, the valve spring retainer 8. Normally fluid flows out through outlet 4, which may be closed by a further spring-loaded valve (37, Fig. 3), but an adaptor (40, Fig. 4) with alternative outlets (43, 46) and stopping off flow through spring casing 20 may be inserted between the casing 20 and inlet member 34.

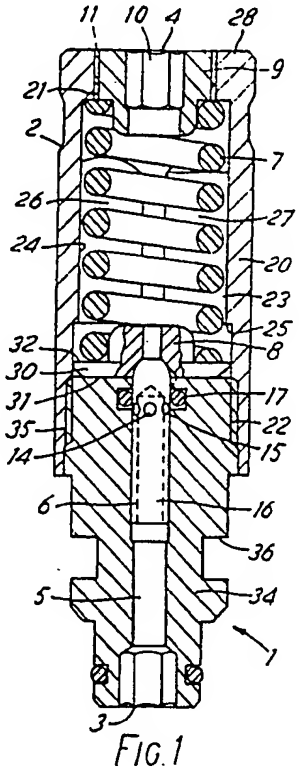

FIG. 1

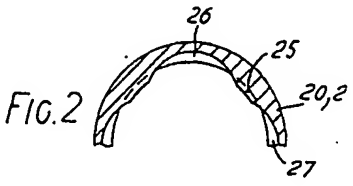

FIG. 2

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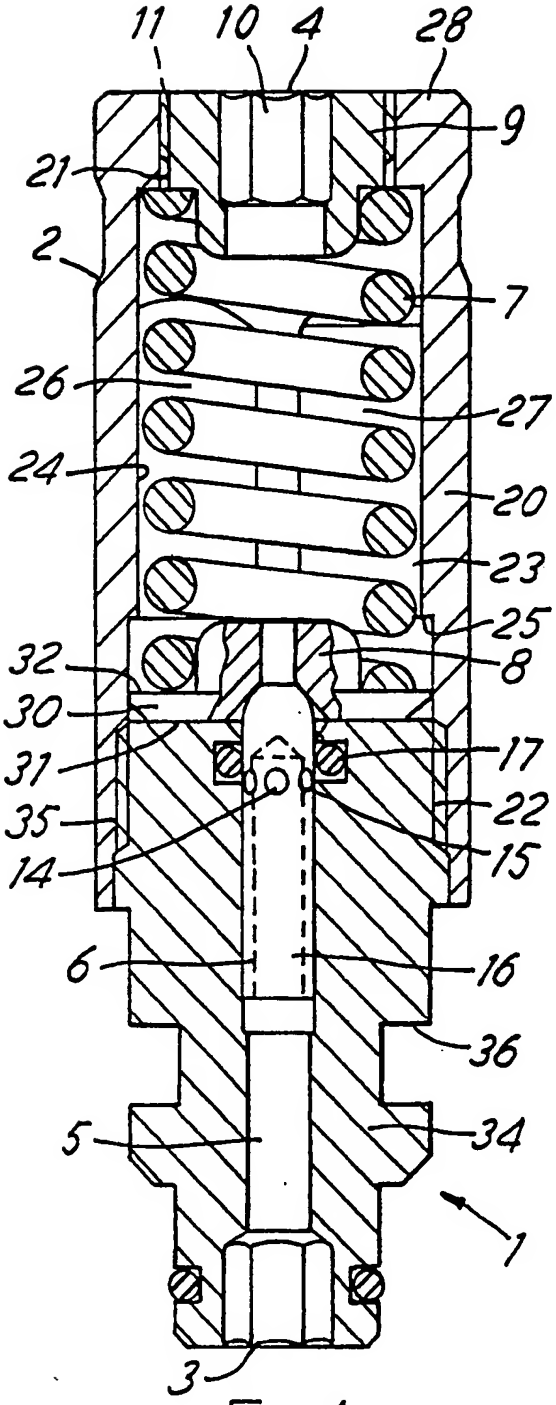

FIG.1

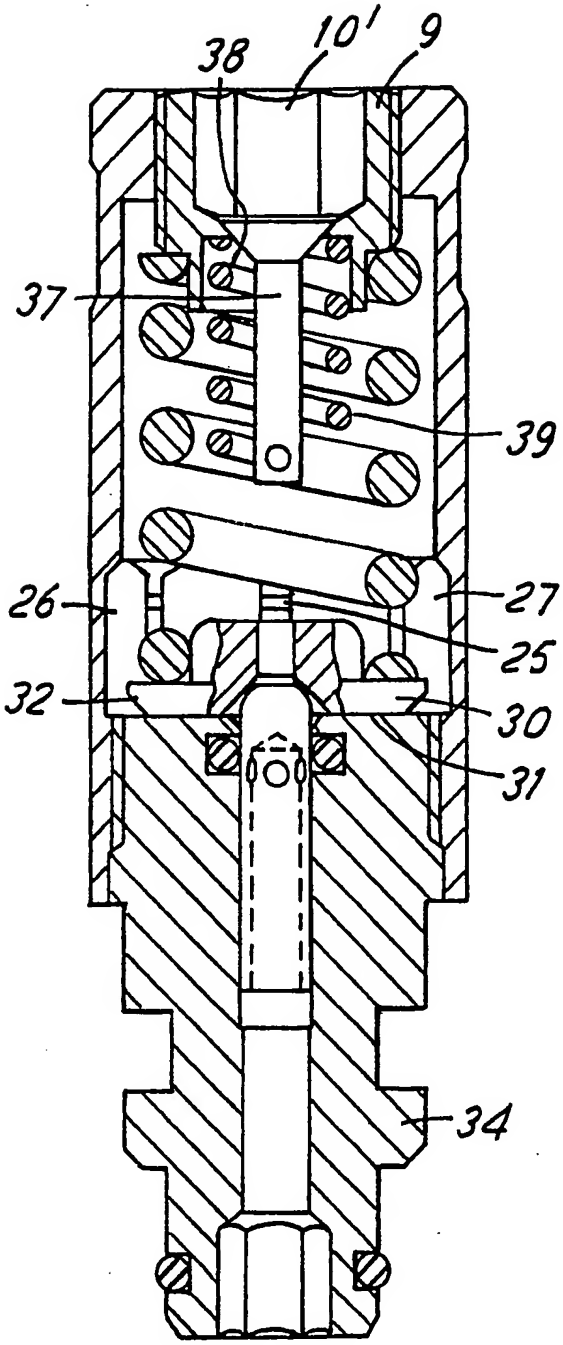

FIG.3

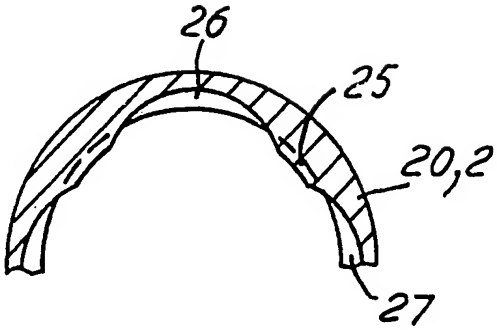

FIG.2

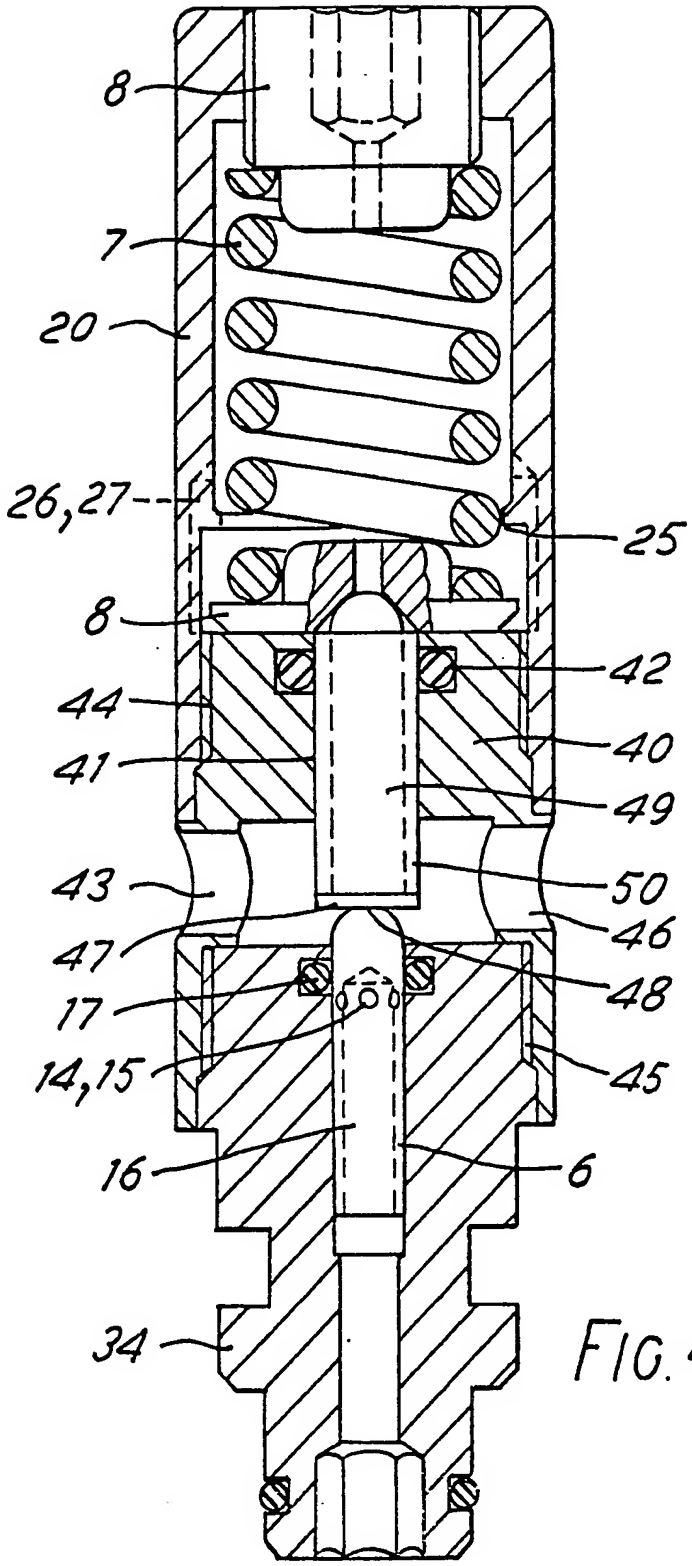

FIG. 4

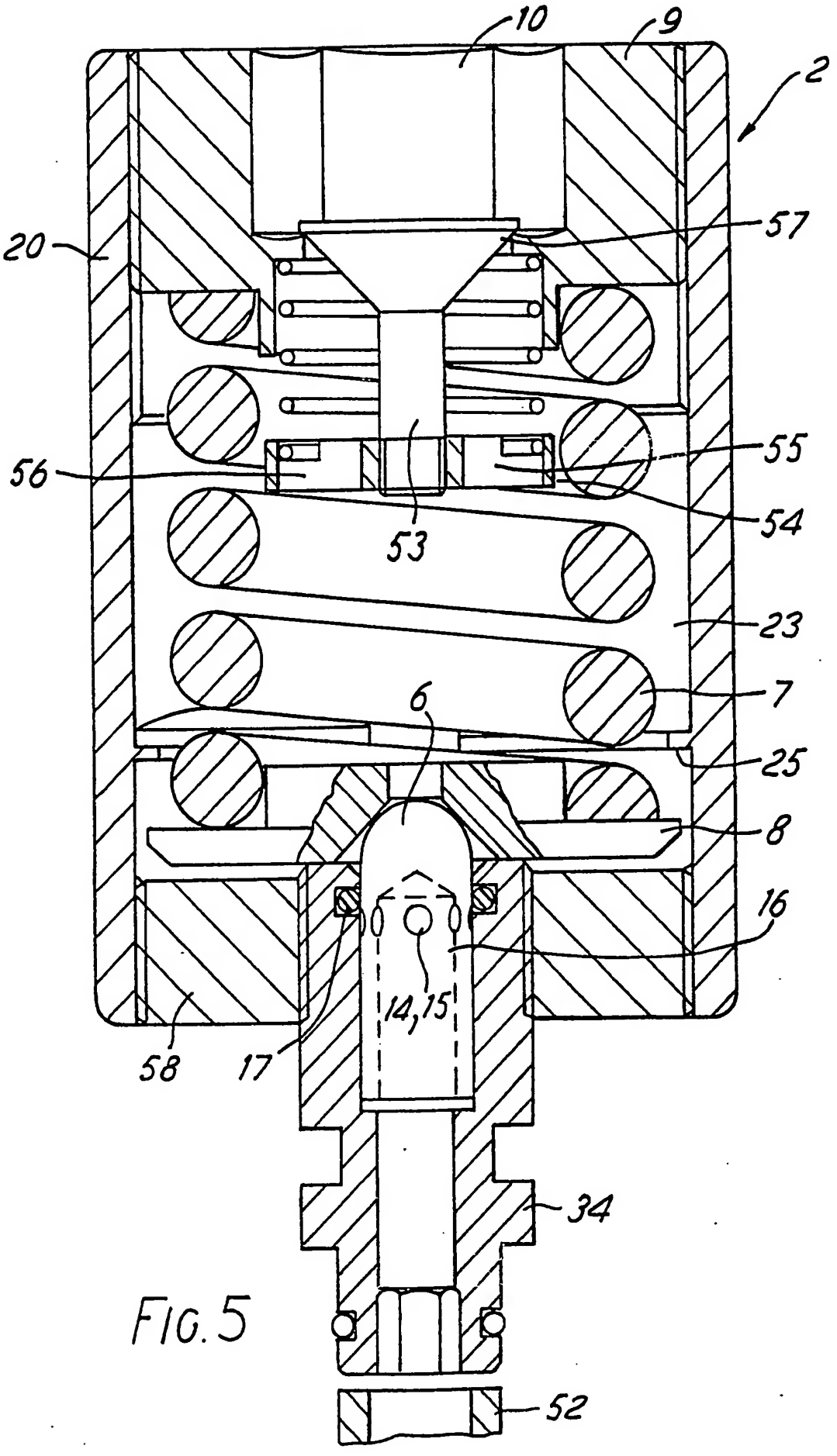

FIG. 5

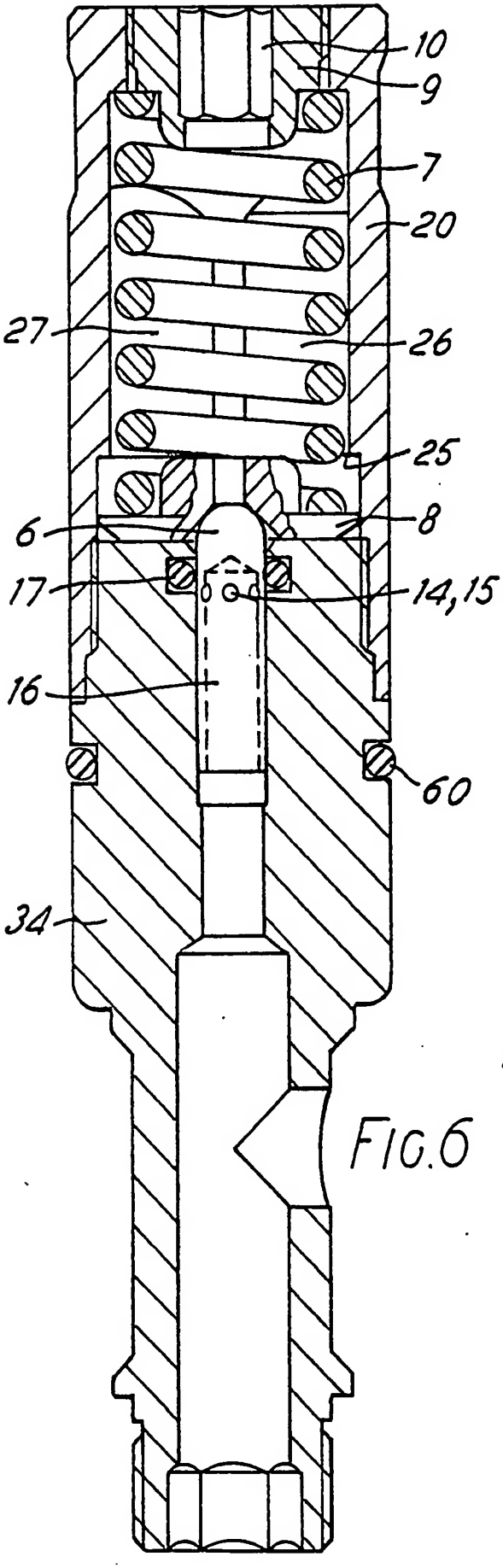

FIG. 6

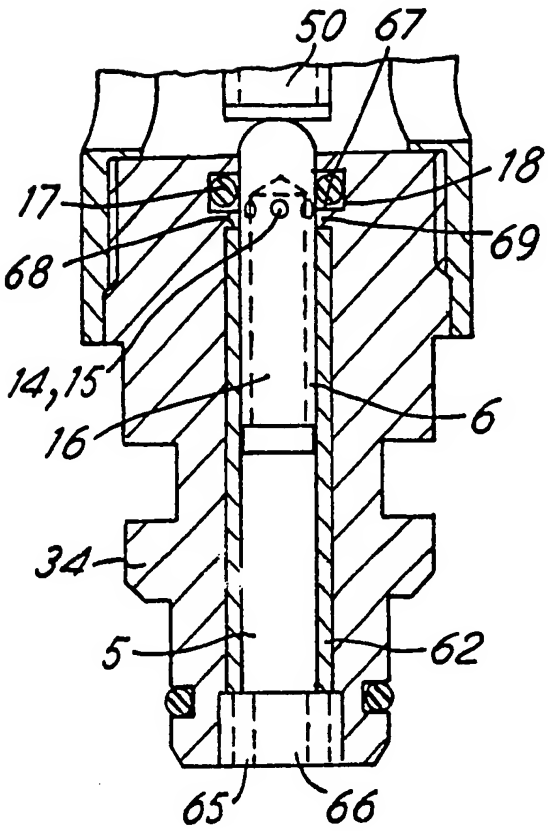

FIG. 7

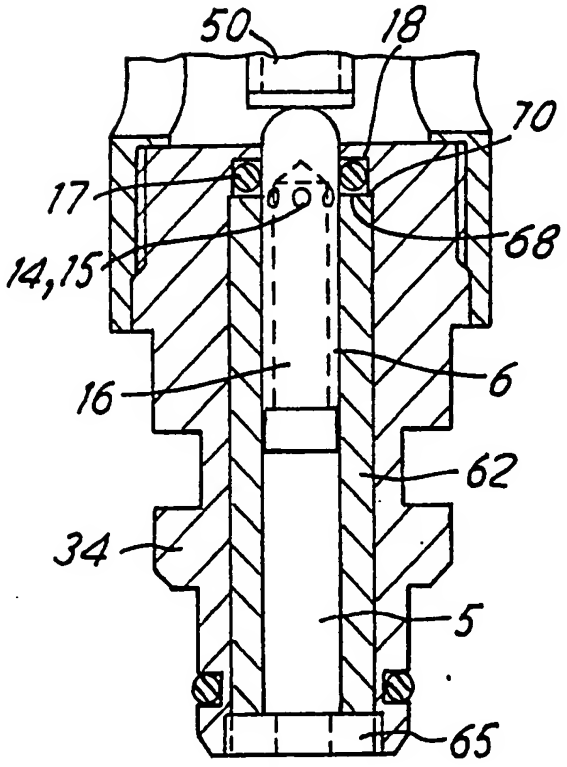

FIG. 8

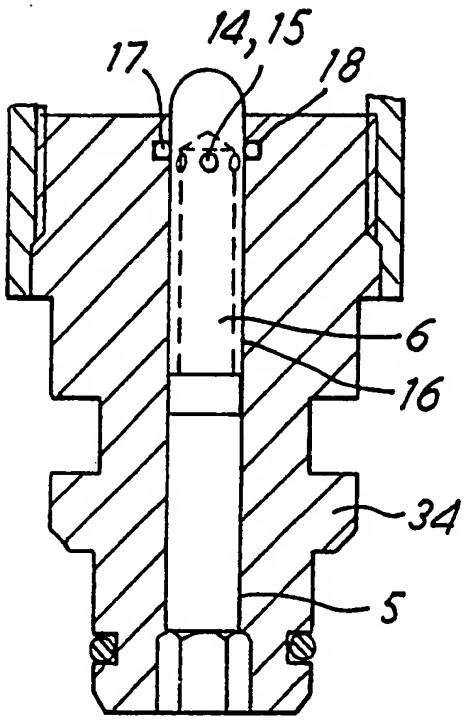

FIG. 9

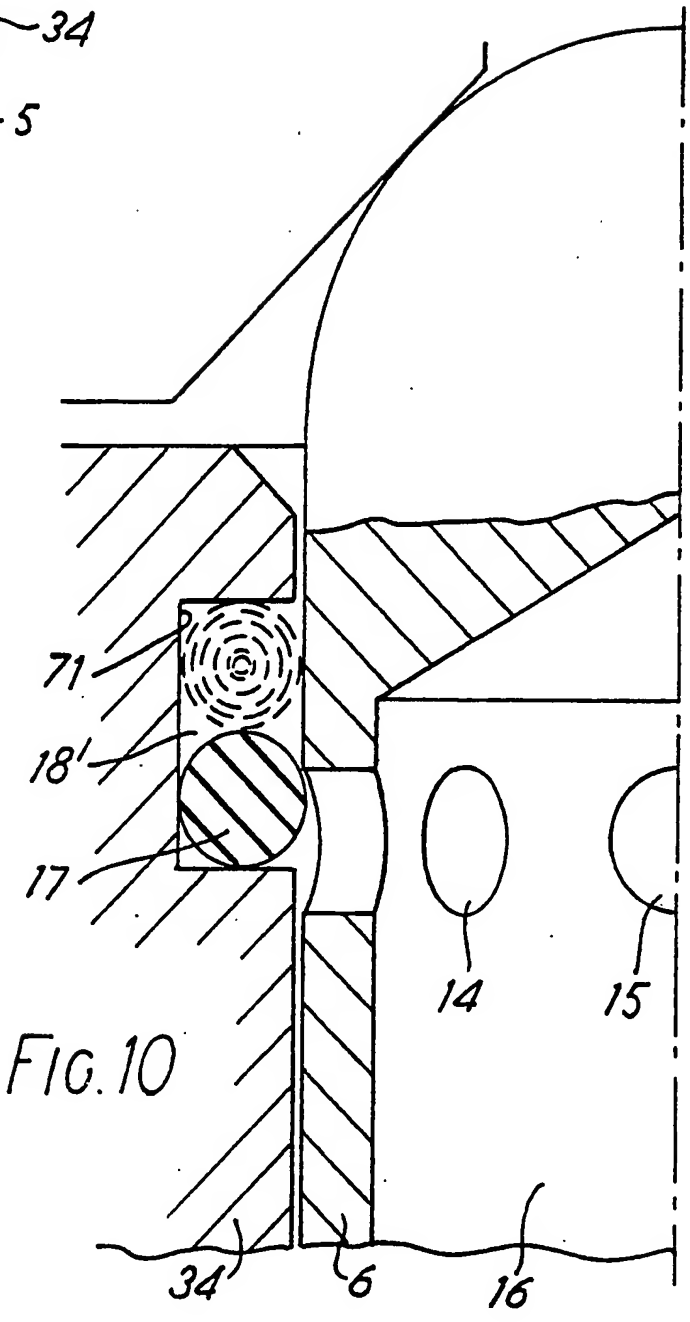

FIG. 10

SPECIFICATION

Pressure Limiting Valve

The invention relates to a pressure limiting valve, particularly for hydraulic lining in underground mining and tunnelling with a valve body, the inlet and outset sides of which are isolated by a spring loaded valve piston adapted for a degree of displacement which is limited by an abutment and which is located in the piston bore associated with the inlet side of the valve or, in the event of overload, are connected, the valve piston being biased by the valve spring via a valve spring retainer and, in the position of closure, being sealed by an O-ring inserted in a groove.

Such pressure limiting valves are used where the occurrence of an overload might cause damage to the system, particularly in the form of hydraulic props. In underground mining and tunnelling, in longwork, the space required for travelling, mine ventilation and haulage is kept open by hydraulic props and by powered support assembly units, preferably in the form of shield-type supports. According to the regulations laid down by mine inspecting bodies, these and other hydraulic systems must be safe-guarded by pressure limiting valves. In underground mining, hazards are created in particular by rock bursts and sudden settlement of the roof. The sudden bursts can so overload the individual props or the entire system that lasting damage or even destruction results. Therefore, very exacting demands are made of pressure limiting valves.

However, the hitherto known pressure limiting valves do not afford the necessary operational reliability by virtue of their design and equipment. Known from DOS 33 14 837.6 is a pressure limiting valve in which a valve piston disposed for displacement in a valve body is biased by a spring having a flat characteristic. This spring is described therein as a soft spring, with no further details which would be necessary for design purposes. The axial bore provided in the valve piston ends approximately at the height of the radial bore and as a blind bore, and in the position of closure the radial bores of the valve piston are isolated by an O-ring from the outlet orifices of the valve body. The O-ring is let into an annular groove and is so constructed that it guarantees the necessary seal. When the valve responds, the valve piston is displaced beyond the O-ring against the force of the valve spring so that the pressurised medium can escape through lateral outlet orifices and the through bore in the setscrew. Such a pressure limiting valve if it is properly designed operates within the acceptable tolerances. Certainly, correct design of the spring in particular is prerequisite.

Nevertheless, difficulties arise because the pressurised medium cannot be expelled quickly enough from the zone of influence of the valve retaining spring, so that the accuracy of response suffers considerably. Another disadvantage is that the cost of manufacture is burdened by the particular construction of the valve piston with the abutment edge which ensures operation of the pressure limiting valve and the overall construction of the valve. Also, there is no clear teaching concerning the design of the valve spring.

The invention is based on the problem of providing a pressure limiting valve which permits of considerable throughput for a short travel to guarantee a rapid and undisturbed discharge of pressurised medium combined with a high reliability of response.

According to the invention, the problem is resolved in that the valve spring retainer is streamlined on its underside and in that the inner wall of the valve body has throughflow passages and an abutment which limits the travel of the valve spring retainer.

An essential problem with the known pressure limiting valves is that the valve pistons 6 easily shear off in the region of the radial bores 14, 15 so that the entire pressure limiting valve becomes useless. The webs located between the radial bores 14, 15 are namely subjected to a tensile stress when the pressure limiting valves responds, because the valve piston 6 is held fast at its bottom end by an abutment which is constructed there.

In the case of the pressure limiting valve according to the invention, on the other hand, these webs are not tensile stressed but compression stressed. This results from the fact that when the pressure limiting valve responds the valve piston 6 presses against the valve spring retainer 8 and presses this then against the abutments 25 in the valve piston 2. Also in the extreme position, therefore, only compressive forces act on the webs of the radial bores 14, 15 so that substantially longer working life can be achieved with the pressure limiting valve. Such a pressure limiting valve operates advantageously without disturbance, since the pressurised medium is discharged in a way which is encouraged by the valve retaining spring and by the throughflow passages constructed on the inner wall of the valve body, the accuracy of response being substantially increased and improved by this even discharge of pressurised medium. By virtue of the fact that the features which promote discharge of pressurised medium are provided in the valve body itself, where there are also provided abutments to limit the movement of the valve retaining spring and thus also of the valve piston, the cost of manufacturing such pressure limiting valves is substantially reduced. Another advantage is that the pressurised medium can flow into the large inner zone of the valve body without any substantial changes of direction or flow-enhancingly constructed diversions and can be flushed out of the valve body without difficulty. By virtue of this fact, a throughput of 100 litres/min is achieved with a high security of response.

In order further to minimise the manufacturing costs, it is according to the invention envisaged that the valve body consist of a spring sleeve having at both ends a screwthread and being at the inlet end sealed by a guide provided with an external screwthread and a connecting member and outwardly by a setscrew biasing the valve spring. At the same time, this also improves the reliability of

response, since such a construction of the valve body or of the entire pressure limiting valve simplifies manufacture and thus also the monitoring of quality in such pressure limiting valves. This construction provides a unit type of design, since the guide with the connecting member can be adapted to a particular instance of usage without the other parts of the pressure limiting valve having to be changed. Thus, such a pressure limiting valve can be used for any application, in fact with in principle always the same basic component parts. All that is necessary is to adapt individual parts to the particular application. Spring flutter which used to occur with such pressure limiting valves cannot arise since the diameter of the valve spring retainer is greater than that of the valve spring.

For the streamined construction of the valve spring retainer, it is according to the invention envisaged to provide the valve spring retainer with a downwardly chamfered edge. The edge can also be rounded off, in which case, as described, the spring will rest on the retainer as a whole or a corresponding distance will remain between the outer edge of the spring and that of the valve spring retainer. Furthermore, this gap makes it possible for the valve spring retainer to move up to the abutment constructed in the inside wall of the valve body.

The controlled and accurate response of the pressure limiting valve is assured when, as provided according to the invention, the valve spring has such a spring constant that the spring travel to be negotiated coincides with the admissible increase in pressure. Thus, a man skilled in the art is provided with a teaching as to how he must construct the valve spring in order to guarantee reliable response of the pressure limiting valve. A spring with a flat characteristic or even a soft spring, on the other hand is too inaccurate a designation and leaves the man skilled in the art with the task of ascertaining accurate specifications.

An optimum design of pressure limiting valve is one in which the throughflow passages are constructed in the inner wall of the spring sleeve below or at the level of the valve spring retainer and extend to above the abutment. With through flow passages which are so constructed, the pressurised medium as described can be controlled and so guided and discharged that perfect operation of the pressure limiting valve is guaranteed. The pressurised medium is dispersed rapidly and without hindrance in that six throughflow passages are provided and are disposed on the pitch circle. Thus the manufacturing process is not excessively burdened by incorporation of the throughflow passages and on the other hand a reliable abutment of the valve spring retainer is achieved since in all six bearing points are provided and are distributed over the circumference. The spring is adjusted by the setscrew with a through bore in the cover of the spring sleeve. This is secured by a tapered notched pin.

Ingress of dirt into the spring space and thus a possible adverse influencing of the response accuracy is according to the invention prevented in that the enlarged through bore has associated with it a spring loaded pin with a seat which is opened by the pressurised medium. The enlargement of the through bore is expedient in guaranteeing the throughflow cross-section which is required for regular and rapid dispersal of pressurised medium from the interior of the pressure limiting valve. The spring loaded pin is thereby an effective additional safeguard for the pressure limiting valve, the additional fitment of which is readily possible even with existing pressure limiting valves, since it is necessary only to change the setscrew with the corresponding additional components.

For applications where the spring is to be kept free from the pressurised medium within the pressure limiting valve, it is advantageous to fit between the valve spring retainer and the guide with the valve piston an intermediate member with an intermediate piston sealed by an O-ring and lateral outlet ports, corresponding screwthreads being provided. Thus, the pressurised medium is discharged laterally from the outlet ports without entering the region of the spring at all. The intermediate piston facilitates achievement of the necessary fitting accuracy particularly since, in addition, it has the advantage that by simple insertion of the intermediate member with the intermediate piston, the previous component parts of the pressure limiting valve can remain unchanged. All in all, therefore, there is a further unit construction system available which is eminently suited for underground use by virtue of the concordance of selection.

To increase operational reliability still further, it is expedient for the intermediate piston to be constructed as a steel pin mounted in a friction reducing synthetic plastics bush. Particularly suitable for this is a Teflon coating or a Teflon bush in which the steel pin is pushed to create the necessary stability.

The pressure limiting valve explained permits of a throughput of 100 l/min. This throughput rate can be increased to 400 l/min if the throughflow areas of the axial bore and of the radial bores of the valve piston, of the bore in the spring sleeve which accommodates the valve spring and of the through bore in the setscrew are equal to or greater than the throughflow area of the given feed line. In this way, all the pressurised medium which is supplied by the feed line is, when the pressure limiting valve responds, reliably passed through this so that cross-sectional variations or the like cannot have any or at least any effective influence. The accuracy of such a pressure limiting valve is thus particularly high. Such a pressure limiting valve can be used as an individual prop valve if the guide is lengthened and adapted to the valve sleeves of individual prop valves or housings of control units. The range of application of such pressure limiting valves is thus substantially increased, and it is advantageous to be able to resort to in each case the same construction principle. Since thus the valves can pass through the same production line for all manner of applications, it is ensured that all pressure limiting valves will

achieve the same values, particularly in terms of safety.

An easier and more accurate fitting of the O-ring is possible if the piston bore is widened right through as far as the O-ring groove and is constructed to accommodate a friction diminishing synthetic plastics tube, the inside diameter of which is adapted to the outside diameter of the valve piston. The large piston bore facilitates insertion of the O-ring. A sufficiently reliable seat remains for the O-ring because it is fixed on the one hand by the top edge of the groove and on the other either by its bottom edge or by the inserted synthetic plastics tube directly. The pushed-in synthetic plastics tube is secured at the bottom end against being unintentionally pushed out. Surprisingly, therefore, it is possible to reduce the closure values once again by around 50%, namely to 5 to 10 bars. Finally, the minimal wear experienced by virtue of the pushed-in friction diminishing synthetic plastics tube is an advantage. Expediently, a tube consisting of Teflon is used for this purpose, particularly since this material, even if it is of thin gauge, has the inherent rigidity which is advantageous for insertion.

Insertion of the O-ring and its exact positioning are substantially facilitated if, as provided by the invention, the piston bore is widened out to the diameter of the groove and if it is constructed so that it simultaneously co-operates to form the groove. With this construction, the O-ring is simply placed on the top end of the synthetic plastics tube and inserted together with this latter. Since the synthetic plastics tube is correspondingly accurately dimensioned, thus also the exact positioning of the O-ring can be guaranteed. Advantageous is the extremely simple insertion of the O-ring, which substantially facilitates assmebly work. Therefore, since jamming of the O-ring is for practical purposes entirely out of the question, assembly can at the same time also be carried out substantially more reliably and in fact by less skilled personnel.

A further shortening of the necessary travel of the valve piston is achieved if the O-ring let into the groove is of the same or slightly less thickness than the diameter of the radial bores. In contrast to previous opinion, it has surprisingly been found that it is entirely possible to use an O-ring having a diameter which is less than the diameter of the radial bores. Also the smaller diameter O-ring provides an accurate seal in the position of closure but can advantageously be surmounted with a shorter travel by the valve piston or by the radial bores on the valve piston. By virtue of the shortening of the necessary travel of the valve piston to the point of leakage, the pressure limiting valve responds even more quickly. In addition, assembly is substantially facilitated because an O-ring having the smallest possible thickness can be used. By reason of this small thickness, it can naturally be handled and fitted substantially more easily. Furthermore, if the groove is correspondingly dimensioned, simplification of manufacture of the guide or of the corresponding part of the pressure limiting valve is achieved. With larger valves, particularly where the guide arrangement is increased, it is possible to enlarge the valve piston and thus also the bores which have to be accommodated therein. Here, the O-ring can quite clearly be of smaller diameter or thickness. Whereas in the case of a 5 mm valve piston, the radial bores provided therein should have a diameter of 1 to 1.2 mm and the thickness of the O-ring should be 0.8 to 1 mm, with a 10 mm valve piston, the diameter of the radial bores can be 2.2 to 2.5 mm, and preferably 2.5 mm, while the thickness of the O-ring should be 1.8 to 2 mm, and preferably be 2 mm.

To facilitate assembly, the invention furthermore envisages the groove being longer than it is deep, preferably being of twice the length. With such a groove, the O-ring can advantageously be obliquely located, which substantially facilitates assembly. The efficacy of the O-ring is surprisingly not adversely affected by the larger-sized groove. Instead, the valve piston passes reliably over the O-ring so that a perfect position of closure or opening is guaranteed.

The tightness of the system can according to the invention be further enhanced if the groove has a rear wall constructed to extend in the direction of the valve spring retainer and obliquely to the valve piston. Thus, the O-ring which is displaced in the direction of the valve spring retainer by the pressurised fluid penetrating the groove and by the movement of the valve piston is additionally deformed so that an even more reliable sealing surface is provided.

The invention is characterised in particular in that a pressure limiting valve is provided which has a high response accuracy and which, by virtue of its being constructed on the unit construction principle, can be used for the most widely diverse applications in what is in principle the same construction. So particularly for the hydraulic units or props used in underground mining, a safeguard is provided which guarantees high operational safety. Another advantage is that the design chosen for the pressure limiting valves is such that simple manufacture is possible.

Further details and advantages of the object of the invention will become evident from the ensuing description of the associated drawings which show preferred examples of embodiment with the necessary details and components. In the drawings:

Fig. 1 is a longitudinal section through a pressure limiting valve;

Fig. 2 is a cross-section through a valve body;

Fig. 3 is a pressure limiting valve in longitudinal section, with a dust guard;

Fig. 4 is a pressure limiting valve in longitudinal section, with an intermediate member;

Fig. 5 is a pressure limiting valve with a high throughput capacity;

Fig. 6 is a pressure limiting valve envisaged for incorporation into individual props;

Fig. 7 is a piston bore with a synthetic plastics tube;

Fig. 8 is a piston bore with a synthetic plastics tube;

Fig. 9 is an enlargement with an O-ring and

Fig. 10 is a bottom part of a pressure limiting valve with an O-ring of smaller thickness.

The pressure limiting valve 1 shown in Fig. 1 has a valve body 2, the input side 3 and output side 4 of which are separated from each other by a valve piston 6 disposed for displacement in the piston bore 5. The valve piston 6 is loaded by the valve spring 7 which is resting on the valve spring retainer 8. The spring constant of this valve spring 7 is so chosen that the spring travel to be negotiated is in accordance with the admissible increase in pressure. This guarantees that in the event of an overload, the valve spring can be quickly and reliably displaced by the valve piston 6 and the valve spring retainer 8 sufficiently that the pressurised medium can pass into the interior of the valve body 2 and can spray out through the bore 10 in the setscrew 9. The setscrew 9 is secured by a notched pin 11 or a locking washer with Loctite.

The setscrew 9 is constructed on the inside similarly to the valve spring retainer 8 and is provided with a head which at the same time carries the valve spring.

The valve piston 6 disposed in the piston bore 5 has, distributed over its periphery, radial bores 14, 15 which communicate with the axial bore 16 and which permit pressurised medium to flow through when the valve piston 6 is correspondingly extended. In the condition illustrated, a seal is provided by the O-ring 17 which is mounted in a corresponding annular groove in the part which carries the piston bore 5. In Figs. 1 to 3, a rectangle is shown in the drawings as being at the bottom end of the valve piston 6, to illustrate that from this point, a narrowing of the valve bore 5 ensures that the valve piston 6 cannot slip downwards and out of the bore.

In the embodiments illustrated in Fig. 1 and the other drawings, the valve body 2 is constituted substantially by the spring sleeve 20 which has at both ends a screwthread 21, 22 to accommodate the setscrew 9 at one end and the guide 34 at the other. The spring sleeve 20 is provided with a large bore 23 into which the valve spring 7 can be inserted, as illustrated. Incorporated on the inner wall 24 of this spring sleeve 20 or the bore 23 and forming abutments 25 are throughflow passages 26, 27 which facilitate an even and rapid passage of pressurised medium past the valve spring retainer 8. In the case of Fig. 1, the throughflow passages 26 extend upwards into the region of the cover 28, so that the pressurised medium can with control be passed in the direction of the setscrew 9 and through bore 10.

In the region of the cover 28 of the spring sleeve 20, the valve spring 7 is braced on the spring sleeve and above all on the setscrew 9. Disposed at the opposite end is the valve spring retainer 8 on the supporting part 30 of which the valve spring 7 rests fully. As illustrated, the valve spring retainer has a larger diameter than the valve spring 7, so that the previously encountered valve spring rattle is reliably prevented. The supporting part 50 of the valve spring retainer 8 is of streamlined construction on the underside 31 in that the rim 32 is chamfered off or flattened. The rim 32 can also be of arcuate construction, in which case it must retain a form which ensures reliable application against the stop 25.

Through the external screwthread 35, the guide 34 can be screwed into the spring sleeve 20. As shown, assembly is facilitated if the valve spring 7 and the valve spring retainer 8 can first be inserted or fitted into the spring sleeve 20, fitment taking place through the guide 34, but only after the first few turns of the screwthread have been overcome. Thus, fitment or insertion of the guide 34 with the valve piston 6 on the inside can be secured and an exact fitment of all component parts achieved. Subsequent tightening of the valve spring 7 is then effected via the setscrew 9.

The guide 34 comprises a connection piece 36 which is constructed according to the particular application involved. This connecting piece 36 is, in the example illustrated, constructed for a push-in connection, the O-ring provided at the bottom end ensuring the necessary seal.

Fig. 2 shows a spring sleeve 20 in partial elevation and in cross-section, and it is clear where and how the throughflow passages 26 and 27 are located. In between are in each case abutments 25 which effectively limit the travel of the valve spring retainer 8.

Fig. 3 shows an embodiment in which the throughbore 10 is sealed against dust by additions. For this purpose, a pin 37 is provided which is pressed on the seat 38 by the spring 39. This pin 37 is pressed out of the seat 38 when, upon the valve piston 6 responding, pressurised medium passes into the interior of the spring sleeve 20. The fact that penetration of dust through the throughbore 10' is effectively prevented means that the efficacy or accuracy of response of the pressure limiting valve is additionally enhanced.

In the case of the pressure limiting valve shown in Fig. 4, while the components spring sleeve 20, setscrew 9, valve spring 7 and the other individual parts as well as the guide 34 with the valve piston 6 are retained, a tight seal of the part of the housing which accommodates the valve spring 7 is achieved by an interposed intermediate member 40. This intermediate member 40 accommodates an intermediate piston 41 which is sealed by an O-ring 42. The pressurised medium must and can only escape here through the lateral outlet ports 43, 46.

The intermediate member 40 has an external screwthread 44 and an internal screwthread 45 which are exactly adapted to the corresponding screwthreads of the spring sleeve 20 or guide 34. Thus, this intermediate member can be inserted as a complete component between the existing or correspondingly constructed other parts and a completely effective pressure limiting valve 1 is available. As explained, such a pressure limiting valve has an interior which is completely sealed by pressurised medium and which accommodates the valve spring 7 and possibly in this case, too, the setscrew 9 may be provided with a sealing pin to prevent the penetration of dust into the interior.

At its bottom end, the intermediate piston 41 has a shoulder 47 on which bears the head of the pin 37, the pin head having a flattened face 48. The intermediate piston 41 is constituted by a steel pin 49 which is seated in a synthetic plastics sleeve 50.

Fig. 5 shows a pressure limiting valve for a high throughput capacity. The throughflow area of the axial bore 16 and of the radial bore 14, 15, like the throughflow area of the large bore 23 in the spring sleeve 20 and the throughflow bore 10 in the setscrew 9, are just as large or may even be larger than the throughflow area of the feed line 52. Upon comparison of Fig. 5 with the preceding figures, it is clear that the guide 34 is unaltered in its outside dimensions and has only a correspondingly enlarged piston bore 5. To prevent the penetration of dust, the comparatively large through bore 10 is secured by a sealing pin 53. This sealing pin 53 is biased by a spring which is initially tensioned by the valve spring retainer 54. This valve spring retainer 54 has recesses 55, 56 in order to allow the pressurised medium to emerge rapidly from the pressure limiting valve 1. The sealing pin 53 is therefore tightly seated on the seat 57 in the region of the through bore 10. Also the features which are the object of the preceding Claims are or can be used for expedient further development of the embodiment shown in Fig. 5.

The adapter 58 makes it possible for the guide 34 which has the conventional connection dimensions and the correspondingly large volume valve body 2 or spring sleeve 20 to be used. The adapter provides the necessary connection between the two parts.

Fig. 6 finally shows a pressure limiting valve which can be used in individual prop valves or in control blocks. To this end, it is necessary only to adapt the guide 34 to the relevant conditions, the necessary seal being provided by the external O-ring 60. The upper part of the pressure limiting valve, on the other hand, corresponds exactly to that of the valve embodiments shown in Figs. 1 to 4, including the setscrew 9 with through bore 10, the valve spring 7, the spring sleeve 20 with the throughflow passages 26, 27 constructed on the inside and the abutment 25. Also the valve spring retainer 8 has remained unaltered as has also the connection between guide 34 and spring sleeve 20. The valve piston 6 with the axial bore 16 and the radial bores 14, 15 corresponds exactly to the valve piston 6 of the previously described embodiments.

Fig. 7 shows a synthetic plastics tube 62 inserted into the correspondingly widened piston bore 5. This synthetic plastics tube 62 which has the same outside and inside diameter as the synthetic plastics bush 50, facilitates fitment of the O-ring 17 which in this way can be pushed substantially more easily into the groove 18, the bottom edge of which is, of course, partially dispensed with in the lower zone. This edge is then augmented or replaced by the top edge 68 of the synthetic plastics tube 62.

The inside diameter 64 of the synthetic plastics tube 62 corresponds to the outside diameter 63 of the valve piston 6 so that this latter is reliably and easily guided in the piston bore 5.

The bottom end of the piston bore 5 is occluded by an easily insertable recessed head screw 65 which secured the synthetic plastics tube 62. Also this construction facilitates assembly since after insertion of the O-ring 17 and of the synthetic plastics tube 62, only the recessed head screw 65 needs to be inserted and tightened up to position accurately and reliably the parts which are particularly important to the proper functioning of the pressure limiting valve 1. It will be appreciated that also the valve piston 6 is expediently inserted into the synthetic plastics tube from below so that the O-ring can be inserted into the piston bore 5 even doubled at the time of assembly.

Provided at the top end of the widened-out piston bore 5 is a web 69 to guarantee an accurate positioning of the synthetic plastics tube 62 after insertion. Thus, the bottom edge 67 of the groove 18 is retained although insertion of the O-ring 17 is somewhat more difficult in consequence.

The inner bore 66 in the recessed head screw 65 corresponds in diameter to the inside diameter 64 of the synthetic plastics tube 62 or is larger as Fig. 8 shows. With a larger piston bore, there is at the top end in the region of the bottom edge 67 an abutment 70 which, upon assembly, indicates and establishes the optimum seating for the synthetic plastics tube 62.

Fig. 9 shows the bottom end of a pressure limiting valve 1, particularly the guide 34. The drawing illustrates that also with valve pistons 6 of small diameter, here for example 5 mm, it is nevertheless possible to use easy-to-fit O-rings 17, namely those which have a correspondingly smaller thickness. The thickness of the O-rings 17 fitted in this case is equal to or may even be less than that of the radial bores 14, 15.

Fig. 10 explains a facilitated assembly in the form of a correspondingly large-sized groove 18'. The length of the groove 18' is preferably twice the diameter of the O-ring 17. This O-ring 17 is shown by solid lines in the installed position and by broken lines in the operating position. The rear wall 71 of the groove 18' can extend at a right-angle to the bottom edge 67 of the groove 18 or may be at an angle thereto. Preferably, it is envisaged that the rear wall 71 be constructed to extend obliquely to the valve piston 6 in the direction of the valve spring retainer 8.

CLAIMS

1. Pressure limiting valve, particularly for hydraulic lining in underground mining and tunnelling with a valve body, the inlet and outlet sides of which are isolated by a spring loaded valve piston adapted for a degree of displacement which is limited by an abutment and which is located in the piston bore associated with the inlet side of the valve or, in the event of overload, are connected, the valve piston being biased by the valve spring via a valve spring retainer and, in the position of closure, being sealed by an O-ring inserted in a groove, characterised in that the valve spring retainer (8) is streamlined on its underside (31) and in that the inner wall (24) of the valve body (2) has throughflow

passages (26, 27) and an abutment (25) which limits the travel of the valve spring retainer (8).

2. Pressure limiting valve according to Claim 1, characterised in that the valve body (2) consists of a spring sleeve (20) having at both ends a screwthread (21, 22) and is closed at the inlet end by a guide (34) provided with an external screwthread (35) and a connecting piece (36) and outwardly by a setscrew (9) biased by the valve spring (7).

3. Pressure limiting valve according to Claim 1 and Claim 2, characterised in that the valve spring retainer (8) has a downwardly chamfered edge (32).

4. Pressure limiting valve according to Claim 1, characterised in that the valve spring (7) has a spring constant such that the spring travel to be negotiated coincides with the admissible increase in pressure.

5. Pressure limiting valve according to Claim 1, characterised in that the throughflow passages (26, 27) are constructed in the inner wall (24) of the spring sleeve (20) below or at the level of the valve spring retainer (8) and extend to above the abutment (25).

6. Pressure limiting valve according to Claim 1, characterised in that a spring loaded pin (37) with a seat (38) opened by the pressurised medium is associated with the enlarged bore (10).

7. Pressure limiting valve according to Claim 1, characterised in that between the valve spring retainer (8) and the guide (34) with the valve piston (6) is an intermediate member (40) with an intermediate piston (41) sealed by O-ring (42) and with lateral outlet bores (43, 46) and having a screwthread (44, 45) corresponding to the screwthread (35, 21, 22) of guide (34) and spring sleeve (20).

8. Pressure limiting valve according to Claim 7, characterised in that the intermediate piston (41) is constructed as a steel pin (49) seated in a friction reducing synthetic plastics bush (50).

9. Pressure limiting valve according to Claim 1 and Claim 2, characterised in that the throughflow areas of the axial bore (16) and of the radial bore (14, 15) of the valve piston (6), of the bore (23) in the spring sleeve (20) which accommodates the valve spring (7) and of the bore (10) in the setscrew (9) are equal to or greater than the throughflow area of the feed line (52).

10. Pressure limiting valve according to Claim 1, characterised in that the piston bore (5) is widened out as far as the groove (18) in the O-ring (17) and accommodates a friction-reducing synthetic plastics tube (62) the inside diameter (64) of which is adapted to the outside diameter (63) of the valve piston (6).

11. Pressure limiting valve according to Claim 1, characterised in that the piston bore (5) is widened out to the diameter of the groove (18) and is constructed to accommodate the synthetic plastics tube (62) and to co-operate at the same time in forming the groove (18).

12. Pressure limiting valve according to Claim 1, characterised in that the O-ring (17) let into the groove (18) is of a thickness which is equal to or less than the diameter of the radial bores (14, 15).

13. Pressure limiting valve according to Claim 1, characterised in that the groove (18') is constructed to be longer than it is deep and is preferably twice as long as it is deep.

14. Pressure limiting valve according to Claim 5, characterised in that the groove (18') has a rear wall (71) constructed to extend in the direction of the valve spring retainer (8) and obliquely towards the valve piston (6).

15. Pressure limiting valve as claimed in Claim 1 substantially as described with reference to any one of the examples shown in the accompanying drawings.

Printed for Her Majesty's Stationery Office by Courier Press, Leamington Spa. 12/1985. Demand No. 8817443.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.